

ing of the Society; but he proposes to bring with him to the ensuing meeting of the British Association glass positives on the scale of 80 to 110 inches.

He concludes with suggestions as to photographing the transit:

1°. It is of no use to photograph the moment of the contact, because accuracy is entirely destroyed by the effect of the interference.

2°. It would be better to have the passage photographed at intervals so as to ascertain exactly the moment at which *Venus* passes through a determined meridian on the Sun's surface. The Sun's apparent diameter being nearly the Moon's or 31', it can by his process easily be enlarged to 110 or more inches diameter, one inch corresponding to  $\frac{31'}{110} = 0'.0282$  or  $1''.7$ . By subdividing to one-hundredth, it would be possible to ascertain the position of *Venus* on the Sun's disc up to  $0''.017$  or  $0^s.001$  in time, an amount of precision scarcely obtainable by the method proposed by M. Janssen at the last meeting at Bradford. But he conceives the magnifying might even go to 200 or 250 inches.

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*On a remarkable Structure visible upon the Photographs of the Solar Eclipse of December 12, 1871.*

By A. Cowper Ranyard, Esq.

The structure which I am about to describe is by no means a marked feature on the Indian photographs; indeed, it was not observed until after nearly a year had been spent in cataloguing the details which are to be made out on the different negatives. When, however, it has once been pointed out, no careful observer can have any doubt as to its existence; and the tardiness with which it was observed may perhaps be accounted for by the fact that attention was principally directed to an examination of the dark or partially opaque details of the photographs which correspond to the luminous details of the corona, whereas this was a bright or transparent structure; and bright spots, lines, or patches had always been regarded as photographic defects, and consequently but little attention had been paid to them.

The original negatives are very small: the dark moon is represented by a transparent circle about  $\frac{3}{16}$ ths of an inch in diameter, and the whole extension of the corona could be covered by a sixpence. The separate details of the coronal structure are therefore very minute, and it would be impossible from the examination of a single negative to determine whether any small marking has its origin in some almost microscopic impurity on the collodion, or whether it represents a vast mass of many million cubic miles in

the corona: it is only by a careful comparison of the different negatives that such photographic flaws can be properly eliminated. For this purpose a Catalogue has been made, containing a list of the negatives upon which each detail can be distinguished, and the details entered in the catalogue have also been drawn. In this work I have been fortunate enough to be aided by a most accurate and conscientious artist (Mr. Wesley), for whose laborious perseverance in the task I cannot be too thankful.

All the details cannot be seen on any one negative; in some the structure of the lower parts of the corona is all that can be made out, while in others the middle heights are best seen, the extreme extension of the corona being lost, and the lower parts merged in an opaque mass by reason of over-exposure. Again, on any one negative, all the details cannot be seen at the same time, they only become visible as the plate is examined with different amounts of transmitted light, and with different magnifying powers; for example, the prominence structure which extends to a height of 2' or 3' can only be made out with strong transmitted light, and a moderately high magnifying power, whereas the structure of the corona at a height of from 10' to 15' can only be seen on the background of a bright sky, and is completely lost when a lens is used. The very furthest extensions of the corona which can in some instances be traced to a distance of quite 26' from the Sun's limb can only be seen by reflected light. In making the catalogue no details have been entered or drawn which could not be traced on three of the negatives.

While working at a group of coronal structure\* on the eastern equatorial limb, Mr. Wesley noticed that a small bright spot, or flaw as we then considered it, occupied apparently the same position in negatives 1 and 4 of Lord Lindsay's series. On examining the others of Lord Lindsay's or the Baikul series we found that a bright spot or flaw was more or less distinctly to be traced in the same place on all of them.

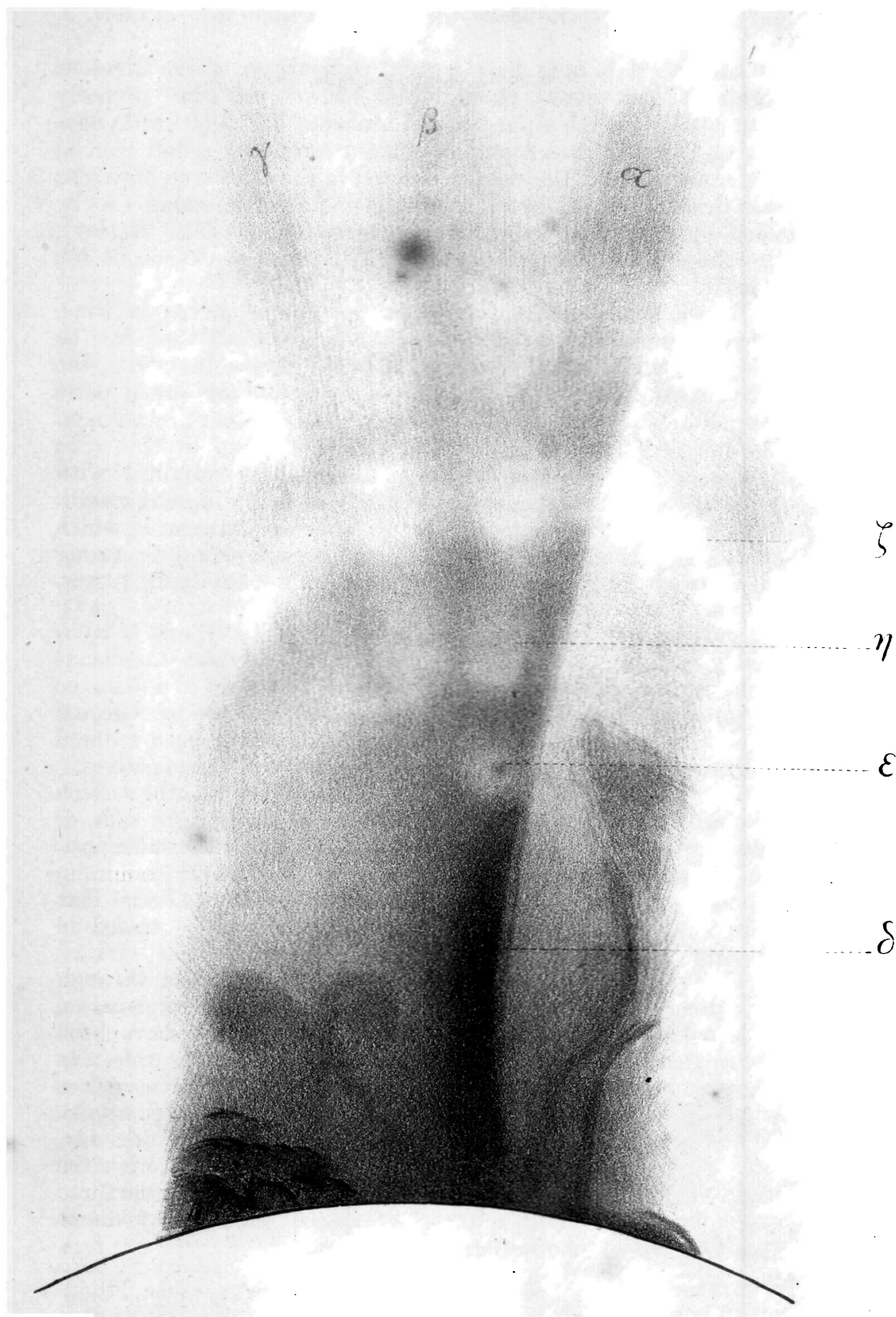
I at first thought that it must be due to a star seen through the corona, but a little reflection showed us that this explanation could not be sustained, for the image of a star would have been represented by a dark or very opaque point, whereas this was bright: and therefore, the collodion had at this point been less acted upon than by the light from the surrounding details. On a closer examination of the plates upon the next fine day, three partially transparent circular arcs, concentric with the bright spot, were detected above it. The middle one of the three arcs is the most distinct, and can be traced without any doubt upon four out of the five Baikul negatives.

\* It should be noted that in the plate appended to this paper the distinctness of the coronal details is intentionally exaggerated. Not only would it have been very difficult to reproduce by lithography the delicate differences of intensity which are traceable in the negatives, but, if it had been possible, the plate would not have so well served the purposes of a diagram.



STRUCTURE VISIBLE UPON THE PHOTOCRAPHS  
OF THE ECLIPSE OF DEC. 12<sup>TH</sup> 1871.

(Black representing opacity in the Negatives)



STRUCTURE VISIBLE UPON THE PHOTOGRAPHS  
OF THE ECLIPSE OF DEC. 12<sup>TH</sup> 1871.

(Black representing opacity in the Negatives)

This circular and concentric structure is so different from all the other forms traceable among the dark details of the corona, that I was loath to accept it as being in any way connected with the Sun. The idea struck me that it might be due to reflexions taking place within the camera, but such reflexions would always have been symmetrically situated with regard to the camera, and therefore always have fallen on identically the same part of the plate; whereas, although the structure is always to be found on identically the same part of the corona, the image of the corona is shifted upon the different plates. Again, any reflexions of a bright image or ghost would have given rise to a dark structure upon the photographs. There seemed, therefore, no alternative but to suppose that the structure was due to some partially opaque body situated between us and the Sun, cutting out or partially intercepting the light of the corona. At this time I had only Lord Lindsay's negatives and two enlarged copies of the Java photographs, to which I could refer. As all traces of the structure were lost on the copies of Lord Lindsay's negatives, I was not surprised to find that it could not be seen on the Java enlargements. After a short time I obtained the loan of Colonel Tennant's original negatives from Mr. De La Rue. They were taken at Ootacamund, a distance of more than 120 miles from Baikul, and I was therefore not a little astonished and pleased to find that the central bright spot was traceable on five out of the six negatives of his series. The central arc was also just traceable on four out of the six negatives, and the inner arc is to be made out on three of the negatives.

In the catalogue the central bright spot has been lettered E. $\epsilon$ . The most distinct of the three arcs is lettered E. $\zeta$ ., and the other two arcs are taken together under the heading E. $\eta$ . The descriptions run thus :—

- E. $\epsilon$ . (Position-angle  $85^\circ$ .) A minute bright spot about  $9'$  from the Sun's limb. It appears to encroach on the Northern edge of E. $\beta$ , and to touch the top of E. $\delta$ . It is best seen upon the background of a clear sky.
- B.1. (*i.e.* negative No. 1. of the Baikul series) distinctly visible.
- B.2. Distinctly visible.
- B.3. Distinctly visible, though not so clearly marked as in B.1.
- B.2. and B.4.
- B.4. Distinctly visible.
- B.5. Just visible.
- O.1. (*i.e.* negative No. 1. of the Ootacamund series) visible.
- O.2. Distinctly visible.
- O.3. Distinctly visible.
- O.4. Only just to be made out and not with certainty.
- O.5. Only just visible.
- O.6. Lost.

E.ζ. A bright arc about  $1\frac{1}{2}'$  broad, with a radius of about  $6'$ , it appears to be concentric with E.ε., and is concave towards the Sun. At its highest part it is about  $16'$  above the Sun's limb. On the South it cuts across E.γ. E.β. E.α. and on the North extends to a distance of about  $4'$  on to the area of D.η.

B.1. Very distinctly visible.

B.2. Quite lost.

B.3. Just visible.

B.4. Very distinctly visible.

B.5. Distinctly seen, though not so clear as in B.1. and B.4.

O.1. Visible, though its central portions are interfered with by a streak (the streak is evidently due to drainage action which took place while the plate was wet).

O.2. Just visible, at first sight it appears to be traceable down as far as the Southern branch of D.ε., but possibly this part of the curve is formed by a photographic defect. It gives a distinctly parabolic appearance to the arc.

O.3. Distinctly visible.

O.4. Distinctly visible.

O.5. Lost.

O.6. Lost.

E.η. The traces of a circular arc much fainter than E.ζ. It appears to be concentric with E.ε., and has a radius of about  $3'$ . The rays E.α., E.β., and E.γ. can be distinctly traced through it, and appear almost to break it up into three bright spots. An outer concentric circular arc with a radius of about  $10'$  is also just visible, but as it can only just be traced upon three of the negatives, a separate letter has not been given to it in the catalogue.

B.1. Distinctly visible; the outer arc is also to be seen.

B.2. Quite lost.

B.3. Just traceable.

B.4. Distinctly visible; the outer arc is also to be traced.

B.5. Just visible with a good light.

O.1. Distinctly visible with a good light, though it is cut across by an opaque streak.

O.2. Just visible.

O.3. Distinctly visible; the outer arc is also to be traced.

O.4. Lost.

O.5. Lost.

No difference can be detected in the position of the central spot and concentric arcs relatively to the details of the corona in passing from the Baikul to the Ootacamund series; and taking into consideration the distance between the two stations, it is evident that the structure must be either due to some dark body in the corona, or to some semi-transparent body situated between us and the corona, at a great distance from the Earth.

The form of structure is similar to that which has often been

observed in the nuclei and the concentric comæ of comets; and it seems not very unreasonable to suppose that this may really be a photograph of a faint though large comet near to perihelion.

On this supposition, it is not perhaps very remarkable that the structure should not have been detected by the many observers who were engaged in examining the corona during totality—for if the comet was similar in chemical composition to those whose spectra have been observed by Mr. Huggins and Professor Young, the loss of light caused by its absorption would have been more readily detected on the photographs than by the human eye, for the two most refrangible bands of the carbon comets lie in parts of the spectrum which produce but a feeble effect upon the retina, though the actinic action is there very strong. The two series of photographs are not sufficiently removed from one another in point of time to show any motion of the comet over the details of the corona. The date of Colonel Tennant's No. 1 negative is about one minute of time after Lord Lindsay's No. 1; and Colonel Tennant's No. 5 is about three minutes after Lord Lindsay's No. 1; but we have been unable to trace any difference in the position of the nucleus in passing from Lord Lindsay's No. 1 to Colonel Tennant's No. 5.

It is worthy of remark that a somewhat similar structure was observed by Professor Winnecke during the Eclipse of 1860. A drawing of it has been published in the *Mémoires de l'Académie Impériale de St. Pétersbourg*, VII<sup>e</sup> Série, Tome IV., No. 1. It consisted of a single parabolic arc, with its convexity turned towards the Sun, and appeared as if drawn with sepia upon the bright background of the corona. Dr. Winnecke describes it, at page 39 of the above Memoir, as "einen parabolisch gekrümmten, dunklen Bogen im Lichte der Corona. . . . Dieser Bogen schien mir gleichsam mit Sepia auf dem lichten Grund der Corona gezeichnet zu sein."

An undoubted comet has been seen projected on the brilliant background of the photosphere (I refer to Pastorff's observations of the Comet of 1819\*). And much fainter comets would be visible when projected on the comparatively feeble light of the corona. It seems, therefore, not very improbable that both this structure and the parabolic arc observed by Dr. Winnecke may have been due to comets which happened to be situated between us and the corona during times of total eclipse. And it is not impossible that such giant comets may exist in great numbers in the immediate neighbourhood of the Sun, though by reason of their faintness, or the short time of their ebullition, they are not visible to us either before or after their perihelion passage.

\* As well as to the nebulous spot observed by him upon the Sun in May 1828. See the *Monthly Notices*, November 1873.